Geophysical Research Abstracts
Vol. 21, EGU2019-2114, 2019
EGU General Assembly 2019

Multispectral Image Analysis and Machine Learning in Soil Micromorphology

Lars Arne Meier, Falk Burkhardt, Thomas Scholten, Peter Kühn, and Karsten Schmidt

Eberhard Karls University Tübingen, Institute for Geography, Department for Geosciences, Tübingen, Germany (lars-arne.meier@uni-tuebingen.de)

Soil micromorphology offers the opportunity to identify soil forming processes in an undisturbed state by description, quantification and interpretation of components and pedogenic features in a soil thin section. Soil micromorphology gives therefore crucial information to chemical and physical soil analyses. Since the quality of the results depends on the experience of the scientist, the quantification of many features is subjective and the reproducibility difficult. In addition, micromorphological analyses are time-consuming, since there is no standard for automated analysis. To overcome such constraints we present a new method, which leads to fast, reproducible and quantitative results. In our method, we combined multispectral image analysis and machine learning to receive an automated identification of common pedofeatures (e.g. clay coatings and FeMn-nodules) and soil porosity as structural information. The multispectral images are obtained by a Sony ILCE-QX1 Camera with a special dual-lens system (Agrowing) to acquire information of the visible (VIS) and near infrared spectra (NIR). We parallelized and preprocessed the images by using the MAVIS Software (Bitmapping). To train the machine learning algorithm, a limited number of pedofeatures was identified within the thin section visually. We used Classification and Regression Tree (CART) and an ensemble learner Random Forest (RF) for machine learning. Prediction accuracy (F1) for CART was between 0.429 (2 pedofeatures and porosity) and 0.633 (1 pedofeature and porosity) while RF was between 0.426 (2 pedofeatures and porosity) and 0.626 (1 pedofeature and porosity). This shows that the combination of multi-spectral image analyses and machine learning can be a valuable new method to analyze soil thin sections in soil micromorphology.
Moreover, data acquirement for training the machine learning algorithms is much less time consuming compared to traditional thin section analyses since only 30% of the pedofeatures on a thin section have to be classified. Despite of our promising results, methodological development is so far based on one thin section with two pedofeatures and soil porosity as variables. Further tests with a large number of thin sections and pedofeatures are the next step. Further, we plan to apply an extended multi-spectral multi-resolution image catalog including many infrared channels at different spatial resolution.